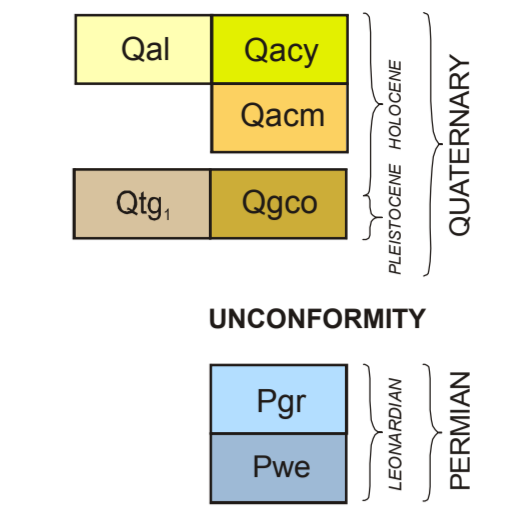


CORRELATION OF MAP UNITS



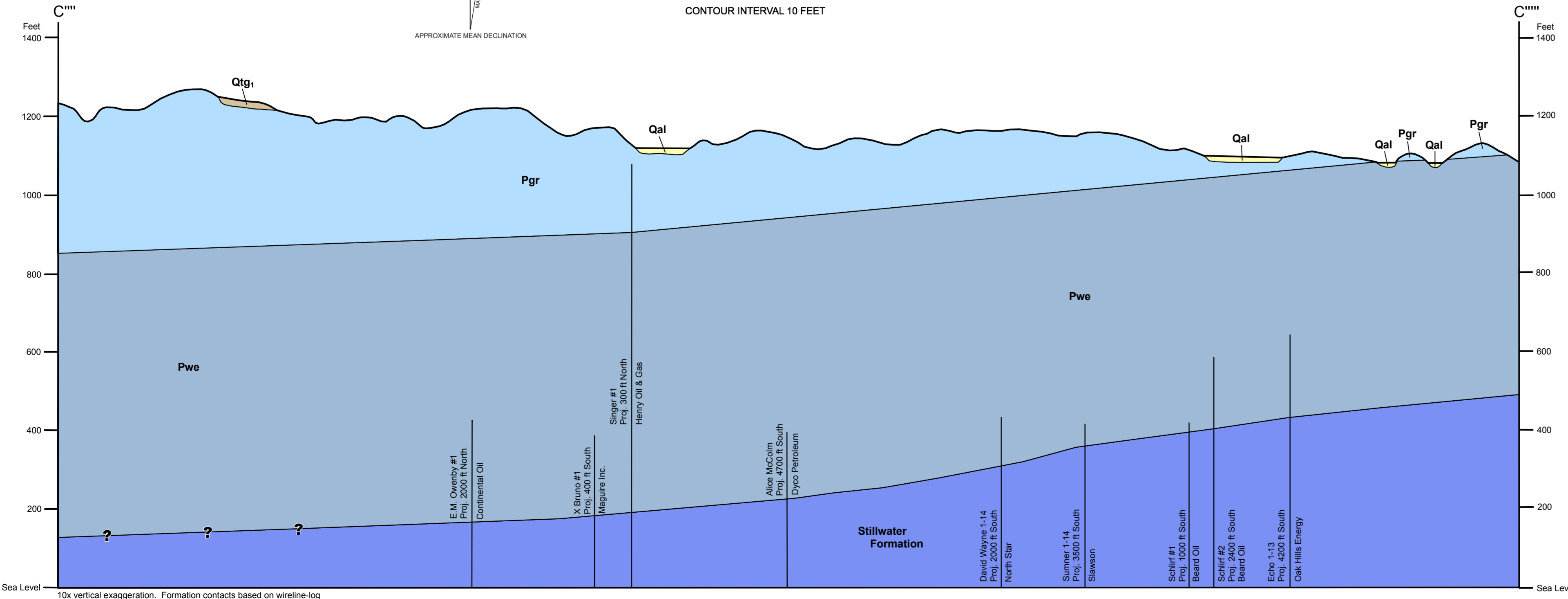
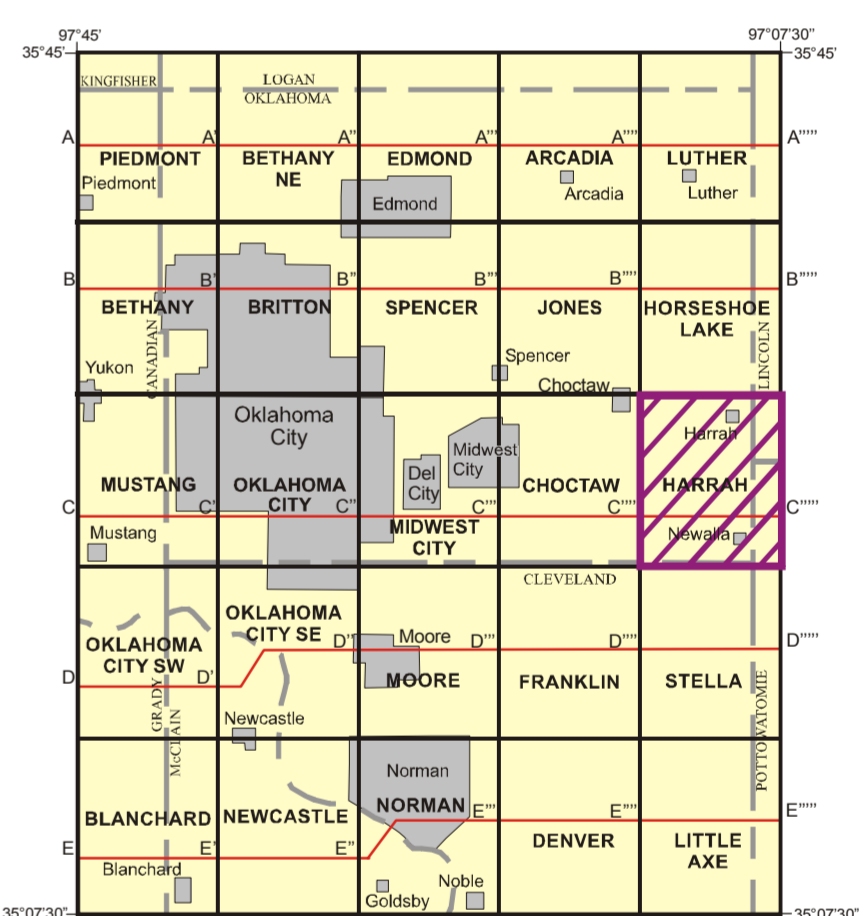
DESCRIPTION OF UNITS

- Qal** ALLUVIUM (Holocene)—Clay, silt, sand, and gravel in channels and on flood plains of modern streams. Includes terrace deposits of similar composition located directly above and adjacent to modern channels and flood plains. Thickness: 0 to about 30 ft.
- Qacy** ALLUVIUM OF NORTH CANADIAN RIVER (Holocene)—Clay, silt, sand, and gravel in channels and on modern flood plain of North Canadian River. Area probably subject to frequent flooding. Thickness: generally 0 to about 40 ft, rarely over 40 ft.
- Qacm** ALLUVIUM OF NORTH CANADIAN RIVER (Holocene)—Clay, silt, sand, and gravel on recent flood plain of North Canadian River about 5-10 ft above Qacy. Area rarely subject to flooding. Thickness: unknown, possibly as much as 50 ft.
- Qqco** REMNANTS OF OLDER TERRACE DEPOSITS (Holocene and Pleistocene(?))—Clay, silt, sand, and some gravel adjacent to the flood plain of the North Canadian River. Sand commonly is medium- to coarse-grained and very light colored; when present, gravel locally consists of concentrations of distally derived pebbles and cobbles, mostly subrounded quartz and quartzite. Base of unit is about 0-100 ft above the modern flood plain of North Canadian River and ranges in elevation from 1030 ft above sea level on the west side of quad to 1200 ft above sea level on east side of quad. The top of the unit is as much as 110 ft above the modern flood plain and is as high as 1220 ft above sea level. Thickness: 0 to 80 ft.
- Qtg** REMNANTS OF TERRACE DEPOSITS (Holocene and Pleistocene(?))—Concentrations of distally derived sediment, mostly very light colored, subrounded quartz grains, with minor quartzite pebbles; sand may also exhibit re-working by aeolian processes into distinct dune structures; base of deposits more than 50 ft above modern flood plains. May represent former course of North Canadian River or eroded re-deposited Pleistocene gravel similar to Qqco. Thickness: 0 to about 20 ft.
- Pgr** GARBER FORMATION (Permian)—Sandstone, mostly fine-grained to less commonly very fine to medium-fine-grained; appears to be very fine grained near base; moderate reddish brown (10R4/6), moderate reddish orange (10R6/6), moderate red (5R5/4), light brown (5YR5/6), and dark yellowish orange (10YR6/6); sandstone- and siltstone-pebble conglomerate, siltstone, and shale are rare. Sandstone typically porous and friable. Commonly weathers to smooth, rounded outcrops; locally with platy to flaggy to rarely slabby appearance. Locally weathers to hard, dark-colored (grayish black [N2]) beds completely cemented with hematite, calcite, and/or silica. Dark-colored sandstone blocks locally form lag deposit over weathered outcrops. Large- and small-scale crossbeds, trough crossbeds common; many outcrops characterized by inclined beds and channelform deposits, although plane-parallel stratification also present. Sandstone locally color-banded (e.g., moderate reddish brown (10R4/6), grayish red purple (5RP4/2), and grayish yellow green (5GY7/2)) or with mottled appearance. Small calcareous and iron-oxide spherules occur locally on weathered surfaces. Circular iron-reduction spots very rare, except in some shale intervals. Sandstone- and siltstone-conglomerates appears to be diagenetic and may represent incipient paleosol development on a sand. Siltstone and shale sandy, color-banded (e.g., moderate reddish brown (10R4/6) and yellowish gray (5Y7/2)) streaks, stratified to unstratified, and with uncommon iron-reduction spots as large as 2 in. in diameter. Typically soft, weathers to "badlands"-type topography. Siltstone and shale common near base, less so in middle of formation. In places, siltstone and shale contain evidence of paleosol development such as blocky weathering, fractures with surfaces marked by small slickensides, or through-going curved fractures. Thickness: about 400 ft, top not exposed.
- Pwe** WELLINGTON FORMATION (Permian)—Mostly a poorly exposed shale with minor interbedded sandstone and siltstone. Shale is moderately to very silty and sandy; moderate reddish brown (10R4/6), moderate red (5R5/4), with local light greenish gray (5GY8/1) streaks; concentrations and septarian nodules rare in Wellington outcrops south of the North Canadian River. Sandstone mostly fine to very fine grained, moderate orange pink (10R7/4) to moderate reddish brown (10R4/6), moderate reddish orange (10R6/6) to pale red (5R5/2), mostly porous and friable, locally with variable amounts of hematite and calcite cement. Siltstone typically color-banded consisting of pale reddish brown (10R5/4) and light greenish gray (5GY8/1) streaks. Sedimentary structures include large- and small-scale crossbeds, trough crossbeds, locally steeply inclined stratification, and less common channelform features. In places, weathers to "slickrock" appearance.

The Garber-Wellington contact becomes increasingly subjective south of North Canadian River due to the increase in thickness of shale intervals at the top of the Garber, coupled with the increase in number and thickness of sandstone intervals toward the base of the Wellington. Also, concretionary shales, common in upper Wellington outcrops north of North Canadian River, are uncommon in exposures south of the river. As a consequence, the top of Wellington is based on the first occurrence of a thick (greater than 10 ft) Garber-like sandstone interval above in conjunction with the last occurrence of a thick shale interval below. Thickness: varies from 620 to 720 ft, based on cross section, but only uppermost 40 ft exposed in quadrangle.

SYMBOLS

- Unit contact; dashed where approximate
- x Outcrop, geologic observation
- Petroleum well. Includes oil, gas, oil and gas, dry service (water supply or injection), junked and abandoned, unknown. Modified from Natural Resources Information System database
- Municipal water well



Sea Level  
10x vertical exaggeration. Formation contacts based on well-log interpretations by T.M. Stanley and surface mapping by the authors. Vertical lines show logs used in interpretations.

**GEOLOGIC MAP OF THE HARRAH 7.5' QUADRANGLE, CLEVELAND, LINCOLN, OKLAHOMA, AND POTTAWATOMIE COUNTIES, OKLAHOMA**

Thomas M. Stanley and Galen W. Miller  
2003

Base Map Credits  
The base map was compiled by the U.S. Geological Survey. Topography from aerial photographs by photogrammetric methods taken 1954. Field checked 1956. Universal Transverse Mercator (UTM) projection; 1927 North American Datum; 10,000-foot grid ticks based on Oklahoma coordinate system, south zone, 1,000-meter UTM grid, zone 14.

Geologic Map Credits  
Geology by Thomas M. Stanley and Galen W. Miller, 2002-2003. Assisted by Lori Bryan and Nicole Baylor. Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under Assurance Award Number 02HQAG0002. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government. Originally published as Open-File Report OF3-2003. Map revised and published as OGG-33. Cartography and layout prepared by G. Russell Standridge, 2003.